Assessing changes in future water usage

Description

Water usage in the UK is known to be very sensitive to weather conditions with demand for water increasing in the summer if the weather is hot and dry. Peak water usage (when usage exceeds the normal baseline) can bring a number of impacts for water supply companies. Climate change is expected to affect water usage in the future as headline findings from the UK Climate Projections (UKCP) show that on average summers will become hotter and drier, with the frequency and intensity of heatwaves expected to increase.

Ofwat (the regulator for the water sector) requires water companies to use scenario testing and define pathways to develop long-term strategies and objectives that are resilient to plausible future climate scenarios. A range of climate change scenarios were used to help Severn Trent Water understand how to adapt their plans to the different climate pathways and define what needed to be measured at both asset and system level to monitor responses to climate change.

A novel approach

The Industry Consultancy team at the Met Office has recently developed a novel approach to assess how peak usage may change in the future due to climate change, building upon our expertise in the water sector and on climate change science. They have worked closely with one water company, Severn Trent, to answer two questions:

1. How does the duration and frequency of peak usage in the current climate change in the future?
2. How does peak daily usage change in the future?

Michael Angus, a scientist at the Met Office explained the steps taken to answer these questions. “By calibrating a statistical model which links water usage to weather conditions, historical and future usage scenarios were generated from historical observed weather data and climate projections (specifically UKCP18) for low, medium and high emission scenarios. Peak usage for Severn Trent in the future (for the time periods 2021-2040 and 2041-2060 for low, medium and high emissions scenarios) was compared to peak usage in the historical period”.

This work found that Severn Trent can expect:

- Small changes to the average duration of peak exceedances in the future scenarios.
- An increased frequency of long-lasting peak usage exceedances, particularly in a higher emissions scenario, due to an increase in high daily maximum temperature values during the summer.
- Higher usage on average associated with a critical threshold, driven by higher maximum temperature values on warmer days.
- On average, more days per year where critical usage thresholds are exceeded.

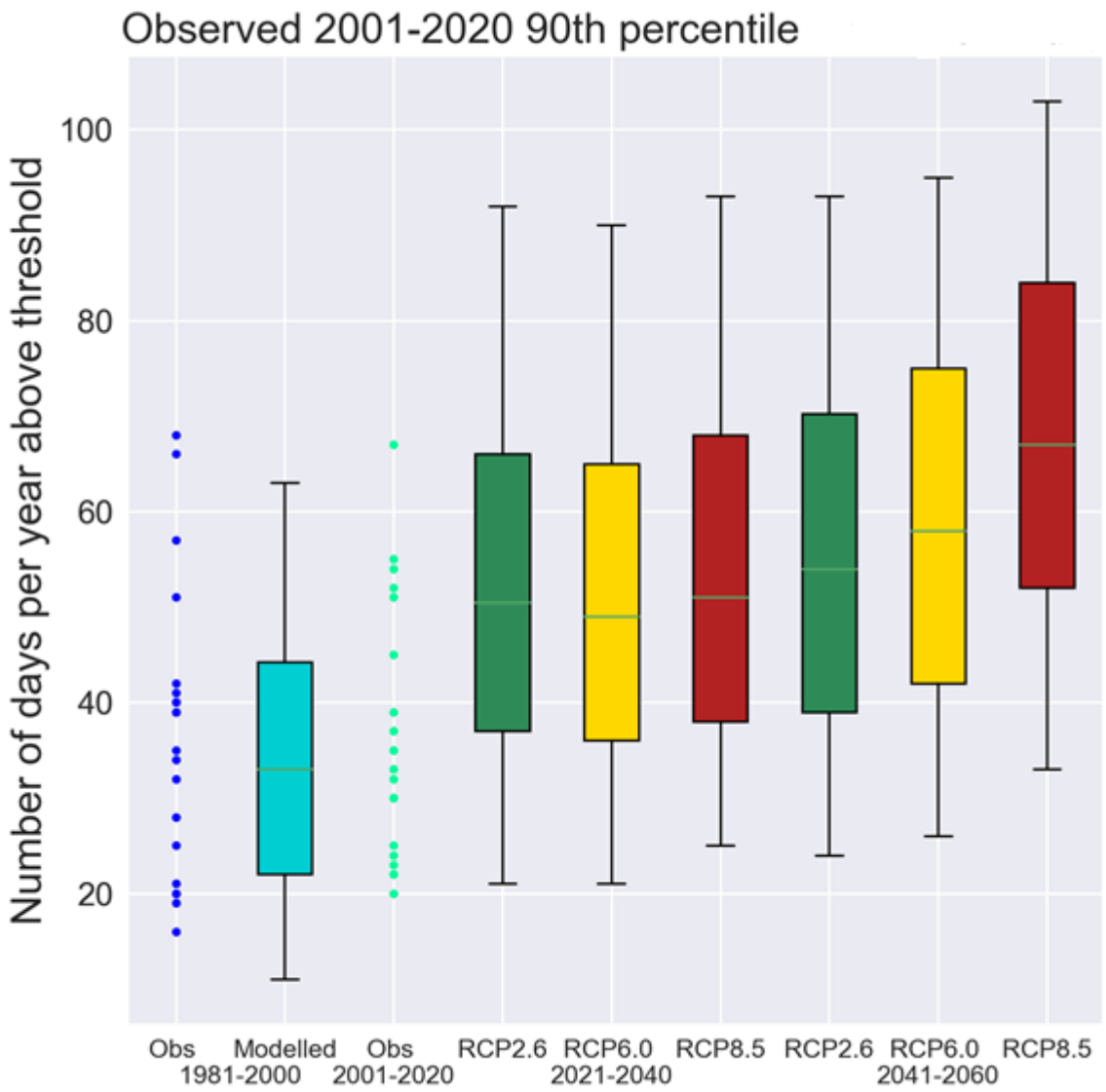


Figure 1: Boxplots showing the spread of number of days per year projected to exceed the historic (2001-2020) 90th percentile of water usage in 2021-2040 and 2041-2060 for low (RCP* 2.6), medium (RCP 6.0) and high (RCP 8.5) emissions scenarios. The number of exceedances per year in 1981-2000 (observed and simulated) and 2001-2020 (observed) are shown for comparison.

*A Representative Concentration Pathway (RCP) is a plausible future emissions scenario.

Useful and actionable information

This collaborative project added rigour and credibility to demand modelling work and helped translate global climate trends to a regional level, bringing to life how the different climate futures could impact customers.

Met Office scientist Isabel Rushby says, “through this work, the Met Office has developed the capability to analyse the impact of climate change on future water usage. There is potential to extend this work using statistical extreme value analysis or by incorporating additional complexity, such as population

growth or changing consumer behaviour”.

The Industry Consultancy team uses its detailed understanding of the water sector, combined with weather and climate science expertise to propose novel solutions for organisations to enable them to make decisions. Translation of often complex climate information into useful and actionable information for organisations is crucial to enable them to improve their resilience and improve services for their customers.

Date Created
September 2023

Delivering transformative change to weather and climate information services in vulnerable African communities through WISER Africa

Description

Across East, West and Southern Africa, communities are vulnerable to weather and climate related shocks such as storms, flood and drought. These can have a significant impact on lives and livelihoods that can result in a loss of income, homes or lives that may have been avoided if better access and use of weather and climate information services was available.

Ahead of this year's Conference of Parties (COP28), this week's Africa Climate Week hosted in Nairobi by the government of Kenya will discuss possible solutions to some of these issues and how organisations can work together to support those affected.

The Met Office manages the Weather and Climate Information Services (WISER) programme, which has been running in Africa since 2015 and has now expanded to include the Middle East and North Africa (MENA) and Asia Pacific. Thus far, WISER has delivered enhanced access to weather and climate information for over 3.3 million households and achieved in excess of £200 million of socio-economic benefits. Through the co-production and co-design of projects, activities and services, the WISER programme has realised a host of outcomes for those that need them most at local, regional and national scales.

Plans for the expansion of WISER's work in Africa were announced in 2022 as part of the Foreign, Commonwealth and Development Office (FCDO) Africa Regional Climate and Nature (ARCAN) programme and this week several projects worth a combined £4.5 million were confirmed in East and Southern Africa. The WISER Africa programme will aim to provide more than 400,000 farmers and urban and informal settlement dwellers with improved weather and climate information. Plans are also underway to support activities in the Sahel.

WISER
Weather and Climate Information Services

WISER Africa will build on the transformational change delivered through WISER to date and provide the opportunity to innovate and expand into new areas and partnerships, while drawing on the lessons learned and best practice from earlier phases of WISER. It will also have a focus on mainstreaming weather and climate information services into policy, planning and decision making to ensure

improvements are made and sustained.

It is estimated that WISER Africa will indirectly benefit 3 million people disproportionately impacted by extreme weather, seasonal events and climate change to become more resilient, and will take the form of national, regional and pan-regional engagement with a wide range of stakeholders engaged in weather and climate activities.

Projects announced this week include:

- **DARAJA project:** Resurgence will lead the DARAJA project to support an inclusive urban early warning initiative spanning cities across East Africa. It will provide early warnings of extreme weather to urban users, particularly marginalised communities based in informal settlements. This builds on the previous phase of DARAJA under the WISER programme, which reached nearly 1 million people and reduced the impact of floods by enabling early responses such as repairing homes and roofs, and cleaning community drains.

- **Early Warning for Southern Africa (EWSA):** An international team led by the UK's National Centre for Atmospheric Science and University of Leeds are delivering the EWSA project to transform access to early weather warning systems for urban communities in South Africa, Zambia and Mozambique. This aims to provide weather information to socially disadvantaged urban populations to reduce the damage caused by storms, by building real-time forecasting capacity and tailoring short-term weather forecasts for those that need them most.

- **Enhancing Climate Change Resilience in East Africa (ECREA)**: The International Centre for Tropical Agriculture (CIAT) are leading the ECREA project, which aims to build resilience of people and countries in East Africa to extreme weather and climate change. It will enable better access to weather and climate information services amongst 400,000 bean farmers and other agricultural sector stakeholders.

These projects are part of a wider £49m funding package for climate finance and resilience projects across Africa announced by the FCDO. UK Minister for Development and Africa Andrew Mitchell, said: "Our partnerships with African countries on green investment and climate resilience are growing economies and improving lives. But more action has to be taken, as those least responsible for climate change are increasingly bearing the brunt of its effects.

"The UK is working closely with African partners to fight climate change, boost resilience and help those whose lives are most impacted."

Date Created
September 2023

Tropical Nights in September

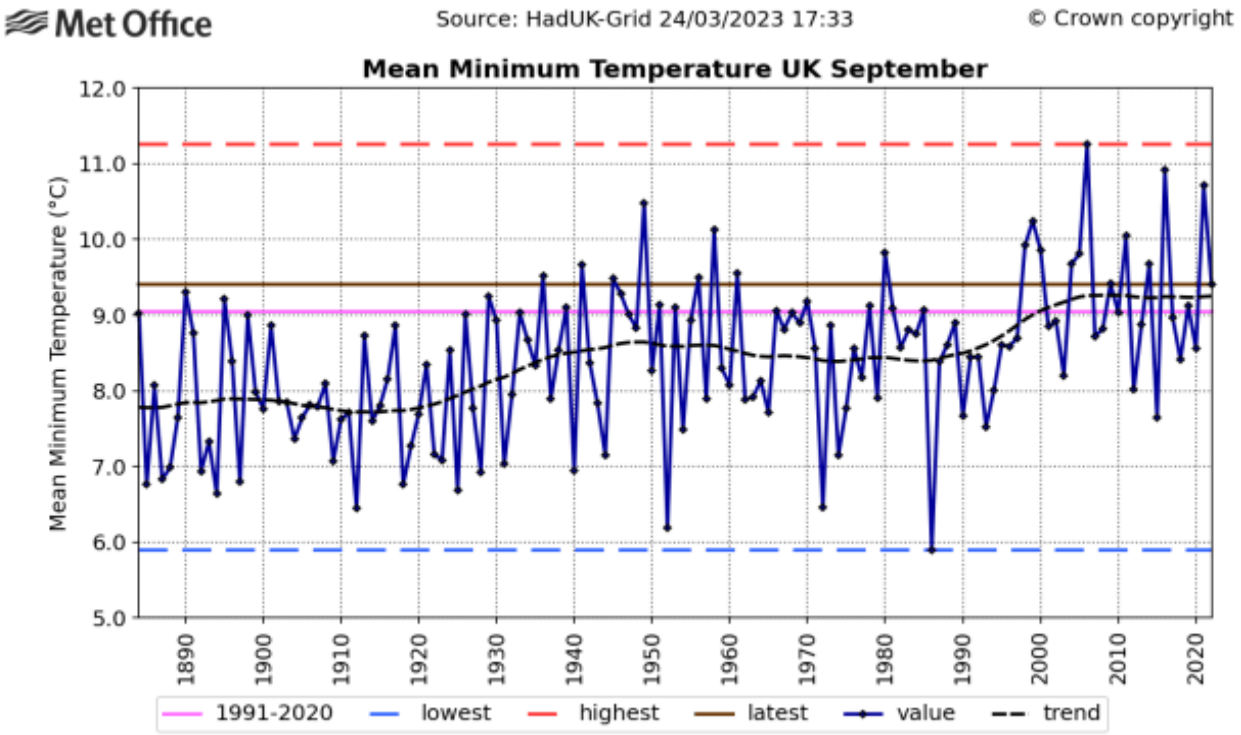
Description

Tropical nights, where the temperature doesn't drop below 20°C, are rare in the UK through September. There have only been a handful of occurrences in the instrumental record, and there have never been consecutive tropical nights recorded in the UK in September. This could change this week as tropical nights are forecast in parts of southern UK possibly through to Friday night.

The highest UK overnight minimum temperature for September on record is 21.7°C, and this record could be threatened on Thursday and Friday nights in particular.

Following the recording of consecutive tropical nights in July last year, the Met Office completed an attribution study examining the influence of human induced climate change on the probability of recording consecutive tropical nights in July last year.

The scientists found the chance of recording three tropical nights in a row during July was less than 1% in a pre-industrial climate with no human greenhouse gas emissions, the probability is now around 20% chance in our current climate. Although this study examined July 2022, it is possible to infer that there will be an increase in likelihood of tropical nights in September too. The graph below shows how UK minimum temperatures in September have increased over the last 130 years.



This graph of mean minimum temperatures in UK Septembers shows minimum temperatures have increased by over 1°C on average since 1890.

Met Office Principal Fellow for Climate Extremes, Paul Davies, said: “As our climate warms we know that we will see more frequent and more severe hot spells, and we’re starting to see the increase in frequency already. Tropical nights can have a significant impact on people and infrastructure as there is no time to recover overnight. It is clear that we’re already seeing the impact of climate change, and we’re likely to see even more tropical nights, even in September, as our climate warms.”

For the latest outlook on how long the heatwave will last, watch the latest Met Office 10 Day Trend below.

Met Office 10 Day Trend

Date Created
September 2023

NASA Space Apps Challenge is coming to Exeter

Description

The Met Office is playing host to NASA's International Space Apps Challenge, with participants from all walks of life invited to take part.

The Space Apps Challenge is a 48-hour global event, with teams taking part from all around the world in the same weekend of 7 and 8 October 2023.

The Joint Centre for Excellence in Environmental Intelligence (JCEEI), which is a partnership between the Met Office and the University of Exeter, and TechExeter CIC are sponsoring the event, which aims to bring diverse teams together to take on challenges set by NASA.

Registration for the free two-day event hosted at the Met Office in Exeter is open now, with around 100 people expected to take part in person, including artists, business professionals, students, tech enthusiasts and creative thinkers.

Challenges set by NASA will require teams to use diverse skills to solve problems, often in unique or

creative ways. There are normally around 25 challenges for teams to choose from, which can be as diverse as creating videos to explain a subject to taking on data analysis and coding, and everything in between.

Exeter's hosting of the challenge will fittingly take place at the Met Office, an internationally-recognised location in meteorology and climate science, and is also home of the Met Office Space Weather Operations Centre, which is one of a handful of 24/7 space weather forecasting centres in the world; monitoring the Sun's activity for the safety of satellites, astronauts and those on Earth.

The JCEEI, which is helping to host the event, brings together world-leading researchers from a range of disciplines to enhance society's resilience to environmental and climate change. It's hoped the Space Apps Challenge will help open science up to the community and inspire some to consider future engagement

The JCEEI's Co-Director Dr Rachel McInnes, hosting the event for the Met Office, said: "The Space Apps Challenge is the southwest's chance to play its part in a global event solving some complex challenges in new and interesting ways. People will work together over a weekend at the Met Office so what we really need is a diverse range of participants who can look at problems in different ways.

"We're thrilled to host this event, bringing exciting science into the community and opening our doors to a wide range of people. This is event is really for anyone with a curious and creative mind who fancies taking on some of NASA's innovative challenges."

The event is free to attend and participants will get lunch and dinner included on Saturday, as well as breakfast and lunch on Sunday, with snacks and drinks also provided throughout. Separate childcare is also available for free for those with young children who wish to attend.

TechExeter community leader Kris Sum said: "SpaceApps brings amazing people together to find our way to solving some of the world's biggest problems. We've seen people make video games, space suits, mars habitats, phone apps, movies and even a song! I can't wait to see what this year's participants will come up with!"

JCEEI Co-Director Prof Hywel Williams from the University of Exeter said: "The Space Apps Challenge will allow teams to explore some fascinating topics and will be great fun for everyone involved. It's a great opportunity for the community to get close to the exciting science being developed at NASA, the Met Office and the University of Exeter."

Each local site taking part in the challenge will nominate winners to be put forward for global judging by experts from NASA, space agency partners and industry. Global winners receive an invitation to the Winners Trip, which will include a visit to a NASA Center.

Register your interest now for the Space Apps Challenge taking place in the Met Office on 7 and 8 October 2023. Registration closes Monday 25 September 2023.

Date Created
September 2023

What do we mean by a climate tipping point?

Description

In the context of climate science, a tipping point refers to a critical threshold in the earth's system or related processes which, if passed, can cause sudden, dramatic or even irreversible changes to some of the earth's largest systems, such as the Antarctic ice sheet or the Amazon rainforest. The resulting socio-economic impacts could be very large, and crossing of one tipping point may then make others more likely to be crossed.

The Intergovernmental Panel on Climate Change (IPCC) AR6 Synthesis Report, published in March 2023, highlights that the likelihood and impacts of abrupt and/or irreversible changes in the climate system increase with further global warming. As warming levels increase, so do the risks of species' extinction or irreversible loss of biodiversity in ecosystems.

Ice sheet loss

The Greenland and Antarctic ice sheets are supported by land. In a warming world, ice lost from these ice sheets runs into the ocean. This raises sea levels globally, with impacts on coastal communities. The AR6 report states that, at sustained warming levels between 2°C and 3°C, there will be an increase in the rate of loss of the Greenland and West Antarctic ice sheets over the subsequent years and decades. The destabilisation of the West Antarctica ice sheet could lead to an additional metre of sea level rise beyond the likely range of between 0.3m and 1m by 2100 (according to the IPCC AR6 Chapter 9: Ocean, Cryosphere and Sea Level Change).

The ice sheets of Antarctica are one of the world's most noted tipping elements. Picture: Shutterstock.

Amazon die-back

The Amazon rainforest offers a range of ecosystem services, including an important role in regulating regional and global climate. Loss of forest could have various impacts, including risks to regional biodiversity, food security and hydropower generation, as well as potentially amplifying global warming. The Amazon is under a range of anthropogenic (human-induced) pressures, including direct clearance or degradation of forest, as well as climate change.

The forest plays a role in sustaining itself, helping keep regional rainfall at higher levels, by returning moisture to the atmosphere through evapotranspiration, and by limiting fire spread. This means that once a certain level of forest is lost, the resulting drop in rainfall and increase in fire spread may prevent regrowth of that part of the forest, even if all anthropogenic pressures were removed.

The south-south-eastern part of the forest is thought to be at particular risk, due to high human activity in that region. Research published earlier this year in Science provides a detailed review of the drivers and impacts of forest die-back or loss and degradation in the Amazon basin.

Slowdown of the Atlantic Meridional Overturning Circulation

The Atlantic Meridional Overturning Circulation (AMOC) is a system of ocean currents in the Atlantic Ocean that bring warm surface water from the tropics northwards, which cools and sinks at high latitudes, before returning south in the deep ocean. A large weakening or collapse (a very weak state)

of AMOC could have devastating impacts, causing cooling in the North Atlantic, large changes in precipitation, shifts in regional weather patterns and large impacts on ecosystems and human activities.

Climate change could weaken the AMOC by reducing the amount of water that sinks at high latitude. Atmospheric warming, and increases in rainfall and ice melt, both make surface ocean water lighter, reducing its ability to sink at high latitude, and weakening the AMOC. Under certain conditions, this weakening may be irreversible, so the AMOC may not recover even if climate change was reversed. The IPCC AR6 report judged that, although a weakening of the AMOC by 2100 is very likely, there is medium confidence that a collapse will not occur.

Taking action

A recent study, led by the Met Office's Dr Richard Wood, stressed the need for more research into such events, which are considered to have a low likelihood of happening, but if they did they could cause very high impacts. Richard's article presents a novel toolkit to manage the specific risks associated with High-Impact, Low-Likelihood events.

Although we don't know exactly when a tipping point may occur, we know that the risk of reaching tipping points increases as global average temperatures increase. Reducing greenhouse gas emissions is critical to limiting warming which would help us avoid the worst impacts of climate change including those which could be caused by reaching tipping points. At the same time, we need to adapt to the changes we are already seeing in our climate and the changes that are expected in the coming decades to make sure we avoid the worst impacts.

We will be exploring the topic of climate tipping points throughout September, so follow the

#GetClimateReady hashtag on X (formerly Twitter) to learn more. You may also be interested in registering for our webinar on this theme on 26 September from 15:00-16:00 BST.

Date Created
September 2023

Unprecedented September heatwave summary

Description

As the weather in the UK turns increasingly Autumnal, it may already seem a distant memory that the start of September saw an unprecedented heatwave in the UK.

For the first time there was a run of seven consecutive days recording 30°C or higher in September. This surpassed the previous longest runs of five days in September 1929 and 1911.

> For the 7th consecutive day running, temperatures have surpassed 30°C in the UK, making this #heatwave the longest on record for September pic.twitter.com/h443Pc97k1
>
> — Met Office (@metoffice) September 10, 2023

It was also a notable spell for overnight temperatures, with the first consecutive tropical nights recorded in September.

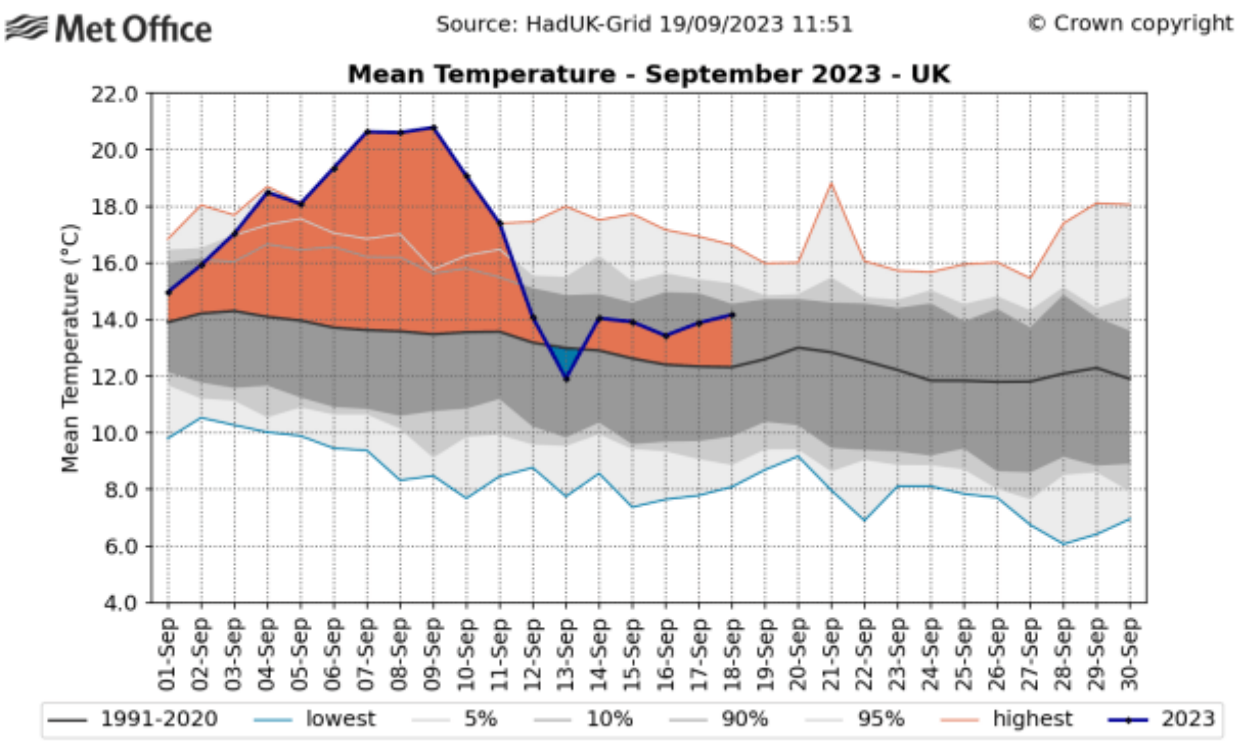
A significant number of long running weather stations broke their September maximum temperature records, some by quite a margin.

A summary of the notable weather event has now been published, with all the statistics and records outlined and contextualised against the historical record.

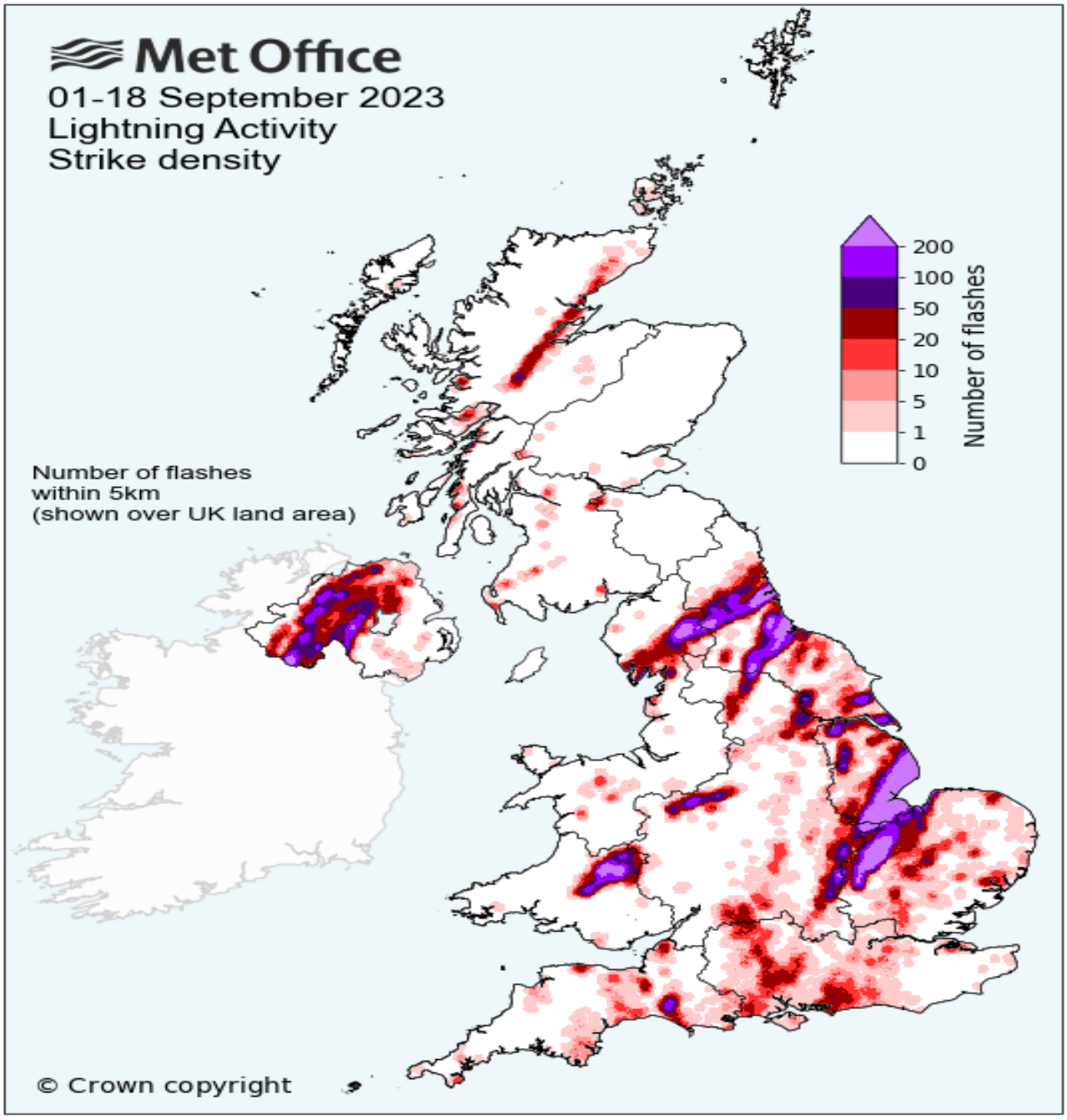
Month so far

The notable heatwave has led to some interesting mid-month statistics for the UK, though these are likely to change as the UK moves into a more typical Autumnal spell of weather.

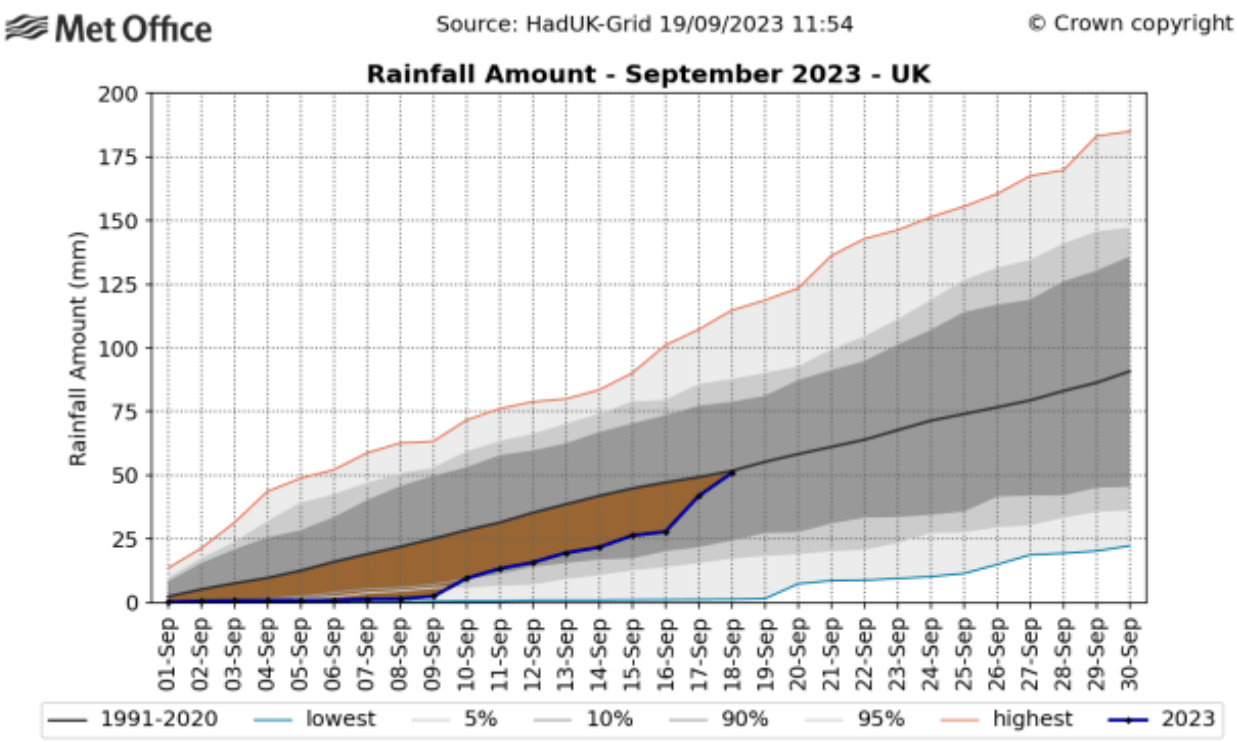
The mean September temperature for the UK is notably above average so far this month, as shown in the graph below. Temperatures are forecast to fall back to normal for the time of year and we are only halfway through the transitional month of September so there could still be a lot of change by the end of the month.



As the heatwave broke there have been a succession of thunderstorms crossing the UK. The map below shows the density of lightning strikes and highlights the areas which have seen the most active thunderstorms through the month so far.



The graph below shows how the heavy rain from these thunderstorms, particularly on 17 September, has put the UK much closer to average for rainfall at this point in the month after what was a very dry start to September.



Date Created
September 2023

Supporting global resilience to weather and climate through WCSSP

Description

A new series of videos and a comprehensive brochure exploring the work of the Met Office managed Weather and Climate Science for Service Partnership (WCSSP) programme has been launched. These recognise the significant achievements of the programme to date due to the committed efforts of those within the Met Office and partner organisations.

Back in 2014, the Met Office established the WCSSP programme on behalf of the UK government's Department for Science, Innovation and Technology (DSIT). Through collaboration with other UK institutions, international meteorological services and governments across participating countries, WCSSP undertakes world-leading scientific research to underpin global weather and climate research and services.

WCSSP has and continues to build a vast global network of partnerships to deliver and evolve essential weather and climate knowledge. Partner countries currently include Brazil, China, India, Indonesia, Malaysia, the Philippines, South Africa, and Vietnam, and research and services produced support increased resilience to protect lives and livelihoods.

Floating islands of plants in Loktak Lake Manipur India during monsoon season. Image: Shutterstock.

Harnessing the extensive weather and climate scientific expertise of over 700 researchers from more than 50 institutes around the world, projects range from the development of solar radiation forecasts in South Africa, to studying the formation of tropical cyclones in Southeast Asia.

The new series of videos explore each of the projects and the programme, in conjunction with a comprehensive brochure including key case studies

that have been developed to demonstrate the value and impact the work has had to date.

Over the last nine years, the programme has delivered substantial impact and benefit including:

- Developing **30** new or improved weather and climate service products, providing new capabilities that are supporting increased resilience to extreme weather and climate change around the world.
- Training over **350** people in a variety of weather and climate change fields, strengthening the research capacity and skill base of institutions and individuals around the world.
- Publishing over **650** scientific papers with more than **14,000** citations in international journals, significantly expanding the global scientific knowledge base. Publications have been viewed over **one million** times.
- Facilitating over **100** research exchange visits between partner organisations, enhancing scientific collaboration and expanding researchers' scientific networks.
- Having research cited in over **150** policy documents from **17** different countries, highlighting its influence on the development of policies, strategies and standards around the world.
- Supporting the roll out of impact-based forecasting systems complimenting the recommendations of the World Meteorological Organisation and the UN Early Warnings for All initiative

Date Created
September 2023

What do climate tipping points mean for the UK?

Description

This month we have been exploring the topic of climate tipping points and provided an overview of the subject in an earlier blog post. In this post, we look more closely at the impacts of potential tipping points on UK weather and climate.

Risk assessment

Understanding the impact of tipping points is an important element of climate change risk assessment, and a Met Office report was produced on impacts to the UK for input to the Third Climate Change Risk Assessment (CCRA3) Technical Report. In this report, three classes of Earth system instabilities were considered – those that could affect the UK directly through changes in our regional weather and climate; those involving changes in land ice, affecting sea level rise impacts in the UK and worldwide; and those related to feedbacks involving carbon or other biogeochemical cycles (e.g., the water cycle). Here we focus on some of the key instabilities which are likely to have the greatest impacts in the UK if tipping points occur.

Atlantic Meridional Overturning Circulation (AMOC)

The AMOC is a system of ocean currents which redistributes heat and carbon throughout the climate

system and is responsible for a mild climate in the UK. Some studies suggest that the AMOC could have a tipping point, with evidence that the circulation has collapsed into a state of reduced flow in the distant past, from climate records taken from geological and biological materials such as sediment and tree rings. Although it is believed unlikely that the AMOC will collapse before 2100, there is scientific uncertainty around this, and a collapse could cause significant and widespread impacts across the UK, Europe and beyond. UK and European impacts are explored in the latest Marine Climate Change Impacts Partnership Ocean Circulation report.

Changes in temperature, wind and rainfall patterns as well as increases in storm surges would have wide implications for the UK such as impacts on agriculture, marine industries and renewable energy production. High wind speeds can cause damage to wind turbines, whilst colder temperatures in winter could have human health impacts and increase energy demand.

Sea level rise

There are two major contributors to sea level rise globally – thermal expansion of water as oceans warm, and an increase in the amount of water in the ocean as ice sheets and glaciers shrink. Of these, increasing water mass accounts for two thirds of sea level rise totals, and a large component of this is due to the accelerating loss of major ice sheets in Greenland and Antarctica. The Met Office climate dashboard provides a comprehensive way to stay up to date on the current state of the climate by providing data based on observations of key global climate indicators including sea level rise. We will also look in more detail at sea level rise tipping points later this month.

Of most concern for the UK in terms of sea level rise is the risk of abrupt change to the West Antarctic Ice Sheet. Current climate projections indicate up to ~1m rise in sea level around the UK by 2100. Under certain circumstances, melting of the ice sheet can rapidly accelerate, and reaching these tipping points could cause ice sheet collapse. This irreversible shrinking of the ice sheet would commit the UK and the world to a much faster rate of sea level rise – up to 2m in the UK this century and even higher sea level rise beyond 2100.These scenarios are included in what are known as H++ scenarios – low likelihood but plausible extreme possibilities for future sea level rise.

Rising sea levels can cause a range of impacts; changing the shape of our coastline and beaches, and threatening infrastructure and the homes of people who live in coastal communities. Rising sea levels can also threaten the survival of already fragile wildlife habitats.

North Atlantic Jet Stream

The North Atlantic jet stream is closely linked to UK weather patterns and there is concern that this could weaken or change position due to a reduction of Arctic sea ice. The position and strength of the jet stream can alter the frequency and/or magnitude of high?impact or extreme weather events in the UK. There is, however, scientific uncertainty about the likelihood of changes to the jet stream and the exact nature of the impacts which would be experienced. As impacts could have notable implications for the UK's weather and climate, research in this area is important to fill those knowledge gaps.

Indirect impacts

Other tipping points may also have indirect impacts for the UK weather and climate. For example, a significant decrease in size of forests such as the Amazon rainforest would reduce the efficiency of

terrestrial carbon sinks – which absorb more carbon from the atmosphere than they release – leading to increased atmospheric concentrations and accelerated global warming. This is turn could cause a cascade of further tipping points as well as other impacts associated with a warming climate.

Impacts of other tipping points around the world could also impact the UK indirectly due to socio-economic instability generated by climate changes elsewhere in the world.

Taking action

Mitigating against a changing climate by reducing greenhouse gas emissions is critical to limiting warming which would help us avoid the worst impacts of climate change, including those which could be caused by reaching tipping points. Some of these impacts will be irreversible and if they happen before emissions are reduced, we will be committed to that impact in the future.

We also need to adapt to the climate changes we are already seeing and the changes that are expected in the coming decades to make sure we avoid the worst impacts. While crossing major climate tipping points may be unlikely, it is important to understand the wider impacts and risks if they were crossed and to develop early warning indicators that would allow society time to respond.

Action is required across all levels of society – to find out more about how you can make a difference, take a look at our Get Climate Ready webpages.

Follow the #GetClimateReady hashtag on X (formerly Twitter) to learn more about tipping points this month.

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